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Proceedings of the Central and Arctic Regional Science Advisory Process on the Recovery Potential Assessment of Wavy-rayed Lampmussel

26 May 2010

Burlington Art Centre
1333 Lakeshore Road
Burlington, ON

Todd Morris
Meeting Co-chairperson

Marten A. Koops
Meeting Co-chairperson

Lynn Bouvier
Editor

Compte rendu du Processus de consultation scientifique régional du Centre et de l'Arctique sur l'évaluation du potentiel de rétablissement de la lampsile fasciolée

le 26 mai 2010

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July 2010 | **Juillet 2010**

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made at the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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SUMMARY

A regional science peer-review meeting was held on 26 May 2010 in Burlington, Ontario. The purpose of the meeting was to assess the recovery potential of the Wavy-rayed Lampmussel (*Lampsilis fasciola*) based on the 17 steps outlined in the Fisheries and Oceans Canada (DFO) Recovery Potential Assessment (RPA) framework. The Wavy-rayed Lampmussel was added to Schedule I of the *Species at Risk Act* (SARA) when it was proclaimed in June 2003. The resulting RPA Science Advisory Report will provide the information and scientific advice required for the Department to meet various requirements of SARA for this species including permitting and development of recovery strategies. Meeting participants included DFO (several sectors), St. Clair Conservation Authority, Ausable-Bayfield Conservation Authority, Grand River Conservation Authority, and the University of Guelph. This proceedings report summarizes the relevant discussions from the peer-review meeting and presents revisions to be made to the associated research documents.

This report will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series on the CSAS website. The working papers presented at the workshop will be published in the form of CSAS Research Documents. The advice from the meeting will be published as a CSAS Science Advisory Report.

SOMMAIRE

Une réunion régionale scientifique d'examen par des pairs a eu lieu le 26 mai 2010, à Burlington, en Ontario. Le but de cette réunion était d'évaluer le potentiel de rétablissement de la lampsile fasciolée (*Lampsilis fasciola*) selon les 17 étapes présentées dans le cadre de l'évaluation du potentiel de rétablissement (EPR) de Pêches et Océans Canada (MPO). La lampsile fasciolée a été inscrite à l'annexe I de la Loi sur les espèces en péril (LEP) lorsque celle-ci est entrée en vigueur en juin 2003. L'avis scientifique découlant de l'EPR fournira les renseignements et l'avis scientifique dont le Ministère a besoin pour être en mesure de satisfaire aux diverses exigences de la LEP pour cette espèce, y compris celles relatives à la délivrance de permis et à l'élaboration de programmes de rétablissement. Parmi les participants, mentionnons des représentants de plusieurs secteurs du MPO, de l'Université de Guelph et des Offices de protection de la nature de Grand River, de la région de St. Clair et de la région d'Ausable-Bayfield. Ce compte rendu résume les discussions pertinentes tenues au cours de cette réunion d'examen par des pairs et présente les révisions qui seront apportés aux documents de recherche connexes.

Ce rapport sera publié dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS), sur le site Web du SCCS. Les documents de travail présentés à l'atelier seront publiés sous la forme de documents de recherche du SCCS. L'avis formulé au cours de la réunion sera publié sous la forme d'avis scientifique du SCCS.

INTRODUCTION

In October 1999, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Wavy-rayed Lampmussel (*Lampsilis fasciola*) as Endangered. Wavy-rayed Lampmussel was subsequently listed on Schedule 1 of the *Species at Risk Act* (SARA) when the Act was proclaimed in June 2003. In April 2010, the status was reassessed by COSEWIC as Special Concern. The reason for this designation was that surveys since the first assessment identified a large, previously unknown reproducing population in the Maitland River and that there is evidence that most of the populations are reproducing. A Recovery Potential Assessment (RPA) process has been developed by Fisheries and Oceans Canada (DFO) to provide information and scientific advice needed to fulfill SARA requirements, including the development of recovery strategies and authorizations to carry out activities that would otherwise violate SARA (DFO 2007).

The purpose of the meeting, as described in the Terms of Reference (Appendix 1), was to assess the recovery potential of Wavy-rayed Lampmussel. The RPA is a science-based peer review process that assesses the current status of the species by addressing the 17 steps in the RPA framework outlined in the Revised Protocol for Conducting Recovery Potential Assessments (DFO 2007). The current state of knowledge about habitat requirements, threats to both habitat and Wavy-rayed Lampmussel, and measures to mitigate these impacts, is included in the Science Advisory Report. A peer-review meeting was held at the Burlington Art Centre, Burlington, Ontario on 26 May 2010 to discuss the Wavy-rayed Lampmussel RPA.

Meeting participants included Fisheries and Oceans Canada, Environment Canada, St. Clair Conservation Authority, Ausable-Bayfield Conservation Authority, Grand River Conservation Authority, and the University of Guelph (Appendix 2). The meeting followed the agenda outlined in Appendix 3.

This proceedings report summarizes the relevant discussions from the peer-review meeting and presents revisions to be made to the associated research documents. The Research Documents (Bouvier and Morris 2010; Young and Koops 2010) provide information on the working papers presented at the workshop, and the Science Advisory Report summarizes the current understanding of the distribution and habitat requirements of this species, along with recovery targets and times to recovery while considering various management scenarios (DFO 2010).

DETAILED DISCUSSION

The meeting co-chair provided the participants with an introduction to the RPA process. This included an explanation of the purpose of the meeting and how the products of the meeting might be used. Draft research documents had been developed by DFO and provided to participants in advance of the meeting. The draft documents were the basis for discussion and participants were encouraged to add to or change the material, as needed, to ensure that the best, most accurate information was included.

SPECIES DESCRIPTION AND HABITAT REQUIREMENTS

Presenter: Lynn Bouvier

The presentation included a description of the Wavy-rayed Lampmussel, its life cycle, as well as the habitat requirements for three life stages (glochidium, juvenile, adult).

The presenter emphasized the importance of host fish to glochidial life. A participant inquired as to the time frame of glochidial metamorphosis; it was indicated that an average of 60-65 days was confirmed by laboratory experiments.

Another participant noted that adults have been found at river depths of 2 m, in contrast to the one meter depth described in the presentation. It was explained that the estimate of 1 m was based on existing literature and reflected sampling limitations, in that it is very difficult to sample waters >1 m. A participant also noted that the 1 m specification was probably meant to reflect the fact that the Wavy-rayed Lampmussel are not a pool species. It was stated that the depth listed in the presentation could be changed.

RECOVERY TARGETS

Presenter: Marten Koops

The presentation on recovery targets discussed recovery target approaches, minimum viable population criteria, the selection process for minimum viable population criteria, the effect of catastrophes, and extinction thresholds.

The question was raised as to how to define a population. The term was used in reference to a demographic population, meaning individuals that interact and reproduce. The presenter also noted that there is dispersal between populations. The participant then asked how one determines where a population begins and ends. Another participant explained that the COSEWIC species sub-committee has typically assigned the term population to mean a watershed and support for this decision is related to genetic analysis that indicated that there is a distinct genetic signature across watersheds that can not be found within watersheds (Zanatta *et al.* 2007). It was clarified that the COSEWIC quantitative criteria used in assessment rely on locations and not populations. It was also explained that in the past (i.e., when the Wavy-rayed Lampmussel was first assessed) populations were thought to be comparable to locations, which is no longer the case. In the case of the Wavy-rayed Lampmussel, there are more locations than populations. Had the new application of the location term been used in the original assessment, it is thought that the Wavy-rayed Lampmussel would have been assessed at a level below "Endangered".

The presenter explained that researchers need to determine how many individuals are required in order to constitute a recovered population. Establishing a target is challenging because there is currently no specification on how to set it. A number of approaches, along with their goals and analytical methods, were presented; demographic sustainability was asserted to be the most effective, given the available data and the modeling approaches that the researchers use. The approach is also consistent with the goals of SARA. When asked if demographic sustainability more or less meant frequency distribution, the speaker responded that it meant large enough populations to withstand pervasion.

There was some discussion surrounding the time frames used as criteria for Minimum Viable Population (MVP). Options established by existing literature are 40 generations, 100 years, and 250 years (one participant asked if these criteria applied only to Wavy-rayed Lampmussel; it was confirmed that this is a general framework used by COSEWIC for all species). The presenter explained that the 250 year timeframe was preferred for this study because it created a consistent timeframe between species. Another participant added that this will not be the case in the future and that the timeframe will need to be reconsidered in further studies.

A cost/benefit analysis has been established as a means of choosing MVP criteria. One participant noted that maximizing benefit for cost is a good idea from a socio-economic perspective. Another liked the idea of standardizing an approach for all species. The analysis provides a range, which one participant noted allows for flexibility in setting goals. A participant agreed that the range does provide a nice trade off between the COSEWIC listing criteria (regulatory side) and the biological needs of the species (scientific side).

The presenter discussed the effects of catastrophes on populations using work done with fish as examples (there was no data on mussels). One participant asked where mussels fit in to the distribution of fish responses to catastrophe. The consensus was that mussels are probably in the middle of the distribution for fish. Catastrophe was defined as a natural or a man-made event which caused a 50% reduction in abundance. One participant used the Ausable chlorine spill as an example. It was noted that catastrophes are difficult to quantify because there is little data and information on these types of events.

A participant asked if there is any specific information regarding catastrophes that would likely harm mussels, such as ammonia spills, human waste, treatment plants, flooding, or low water levels. There was some discussion on this matter. In the end it was stated that spills are recorded, and data exists, but the areas in which the spills occur are not monitored to measure the effects. The presenter concluded that this discussion will offer a starting point from which to examine the role that catastrophes play in mussel survival rates.

The presenter displayed results from probability of extinction studies of the Grand and Thames rivers. One participant asked if the methods assumed that all the mussels in a river were accounted for; the presenter clarified that the graphs represented only the adult females, and that the sex ratios in the populations are not even. Another participant questioned how the presenter explained the differences in the two river systems; the answer was that the Thames River mussels grow more slowly and reach a larger size. It was asked whether fecundity, size, and growth rates are consistent between locations; the answer to that question was not known.

The extinction thresholds were then discussed. All simulations were run with extinction being at less than one adult female in the population. Simulations also assumed that there is random mating and complete mixing of the population. The speaker pointed out that mussels are sessile, and that there is a possibility that extinction may occur at thresholds of greater than one adult female. One participant noted that assuming random mating and complete mixing means that the estimates will be off from what happens in nature; if researchers can answer the question of paternity (which males are fertilizing which females), they could get a better handle on how far sperm travels. Another participant asked if anyone is studying bass populations in the Grand or Thames rivers; no one knew of any such studies. All agreed that this research could help to answer the question of mussel paternity.

The presenter asked if anyone wanted to offer a different threshold number from the one given. A participant observed that the number is arbitrary, so any other number that they give would be

a guess. It was added that researchers need to ensure that the difference between the growth rates in the Grand and Thames rivers is biological and not an error on the researchers' part. A participant noted that there are some tests to tell whether the biology of the rivers reflects the research model.

The question of female fecundity in relation to size of the animal was raised. A participant expressed a need for Wavy-rayed Lampmussel specimens to test. Another offered to obtain different sized females for an upcoming experiment on juvenile survival and test fecundity simultaneously. However, the participant noted that the experiment will only use three individuals. It was agreed that the researchers could not determine a relationship using three data points, but they could see where those points lie in comparison with the model outputs.

There was some discussion surrounding the interpretation of data by recovery teams. It was stated that the numbers need to have a scale so that one can see how the analysis is completed; a participant explained that the report is written in a descriptive style. Another participant asked if researchers should be giving advice on how to interpret the data. The response was that recovery teams make the decision on how to use it, but advice is directed to them. It was emphasized that the methods used for sampling mussels are important because the resulting models are relied on in the decision making process. A participant added that researchers need to be aware of the caveats and limitations of models.

POPULATION STATUS

Presenter: Lynn Bouvier

The presentation on population status included population distribution, abundance and trajectory of the Wavy-rayed Lampmussel, as well as the certainty that the researchers had of the information's accuracy.

A participant suggested that the headers of the table on population density be changed to reflect Wavy-rayed Lampmussel densities and area. There was some confusion as to what the numbers meant. It was stated that the table needed to make clear that the analysis is a relative one.

There was some discussion surrounding the matter of certainty ratings. A participant suggested that the certainty level of the abundance index of the Sydenham River should be a 1 ("Quantitative Data") and not a 3 ("Expert Opinion") because most of the research conducted on the Sydenham River would have used the same methods as the Grand River, which had a certainty of 1. The presenter explained that there were no quantitative estimates on the Sydenham River (none had been caught there), but agreed that zeros and negatives would constitute quantitative data. It was agreed that the rating would be changed.

The question was also raised as to why the population trajectory of the Ausable River was 3; the answer was that it is only expert opinion that the trajectory was unknown. Another participant raised the matter of qualitative data, arguing that it is subjective. It was suggested that the presenter change the St. Clair River delta trajectory certainty values to 3 because the density was based on so few animals that the error around the estimate was high. The presenter agreed to change the rating. A participant also suggested that the presenter add a certainty of 1 to the population status of the Sydenham River and add some certainty to that of Lake Erie.

There was some discussion surrounding how estimates are calculated and how the abundance has increased from past surveys to current ones. It was stated that the reason for the population increase is unknown; a participant suggested that it might be due to improving water quality.

THREAT STATUS

Presenter: Todd Morris

Grand River and Thames River

The presentation on threat status overviewed the likelihood and impact of threats, as well as the certainty associated with threat impact.

It was established that "threat status" refers to the occupied area of the watershed, rather than to specific locations (there is not enough data to offer reliable analyses of the latter). The presenter clarified that the threats are to the mussel and not to the fish host.

The analyses began with assessments of the Grand and Thames rivers. It was confirmed that it is likely that Zebra Mussel will invade the areas that Wavy-rayed Lampmussel inhabit. There is no time estimate for when these events will occur. A participant asked if researchers knew that the Zebra Mussel would out-compete the other mussels; they answer was that they were fairly certain.

Discussion followed the predictions surrounding turbidity and sediment loading, but all agreed with the assessment. A participant asked if there are quantitative studies associated with turbidity; the answer was no, the numbers being used were observational.

Regarding contaminants and toxic substances of the Grand and Thames rivers, one participant asked if the threat likelihood (TLH) should be listed as "known" since there are contaminants present in the rivers. The status was designated as "likely" because the contaminants' effects are unknown. The group concurred that the status of "likely" was preferable to "known".

A participant asked why there was a difference between the TLH for nutrient loading in the Grand and Thames rivers ("known" and "likely", respectively) when the nitrogen and phosphorus levels were higher in the Thames. The assessment was changed so that both were listed as "known". It was added that the study needs to emphasize the things to which mussels are sensitive (e.g., dissolved oxygen and algae growth). A participant also suggested that the author qualify the category so that it includes the indirect impact of nutrient loading.

The category of "Fish Hosts" was defined as an impact on fish which would directly affect mussels. The participants agreed with the assessment, but also agreed that there are other factors that will affect fish hosts.

There was some discussion surrounding the category of altered flow regimes and the place of dams within that category. It was determined that dams can have an impact on flow regimes, but that the category accounts for more than the structures themselves. A participant proposed to change the threat impact (TI) of altered flow regimes to "high", rather than "medium"; there was consensus from the group. It was also suggested that the wording for the category be changed to include factors other than dams.

For the category of "Predation", it was clarified that the study used the COSEWIC definition of the word. The group decided to remove the reference to raccoon predation as being mediated by humans. A participant asked why the impact of natural predators was listed as "low". Another explained that it does not result in a decrease in the abundance of mussels. It was agreed that the category would be reworded to include human harvest and/or consumption.

A participant raised the issues of human predation, human direct habitat alteration (e.g., infills, dredging), and recreational activities. It was agreed that these events would constitute a "low" threat, in part because direct harm is prohibited under SARA. A participant noted that the categories should be altered to separate altered flow regimes from the removal/alteration of physical habitat.

It was established that recreational activities do occur in the Grand and Thames rivers. The TLH was changed to "known", the TI to "likely", the certainty was changed to 3 for both.

The effects of the physical loss of habitat were determined to be cumulative and less significant than predation/harvesting, the introduction of Zebra Mussel, and poor water quality. The Physical Habitat Removal TLH was changed to "known", the TI to "medium", and the certainty to 3 in both the Grand and Thames rivers.

Ausable River and Maitland River

The presentation continued with an assessment of the Ausable and Matiland rivers. One participant asked why there was a TLH of "unlikely" for exotic species in the Ausable. Another answered that no Zebra Mussels had been found near the Wavy-rayed Lampmussel; there are boats in the river, but they are small. No one reported to have seen boats in Wingham (Maitland River). The participants agreed with the assessment.

All agreed to the assessment of turbidity and sediment loading, as well as that of nutrient loading. The TLH assessment of contaminants and toxic substances was changed to "likely" for both rivers to be consistent with the Grand and Thames rivers analyses.

It was determined that the TLH for fish hosts would be left as "unlikely" until researchers could obtain more information on the matter. One participant offered to provide a contact for information on fishing in the Maitland River.

Regarding altered flow regimes, one participant noted that the Ausable will undergo changes as a result of climate change. Another participant added that there is much municipal alteration in the form of drainage in the upper Maitland. The TLH was consequently changed to "likely".

The TLH of predation in the rivers was changed to "known" because it exists, but researchers were unsure of its impact on the Wavy-rayed Lampmussel. The category of "Recreational Activity" was added to account for use of ATVs and fly fishing in the Ausable and Maitland rivers respectively. The TLH was labelled as "known", the TI as "low", and the certainty as 3 for both rivers. Physical habitat removal/alteration was also added as a category; the TLH was labelled as "likely", the TI as "medium", and the certainty as 3 for both rivers.

Lake Erie, Connecting Channels and St. Clair River Delta

The presentation continued with assessments of Lake Erie and its connecting channels, and the St. Clair River delta. The participants agreed with the assessments of exotic species, turbidity and sediment loading, and nutrient loading. The TLH of contaminants and toxic substances for Lake Erie was changed to "known"; although there was some discussion surrounding the levels

of contamination in the St. Clair River, the participants agreed that assessment of "likely" was accurate.

Regarding fish hosts, a participant noted that there are potential impacts from invasive species such as Round Goby (*Neogobius melanostomus*) and Asian Carp (*Hypophthalmichthys* sp.); the TLH was changed to "likely" for both rivers. The issue of climate change was also discussed in relation to altered flow regimes; however, it was agreed that climate change constitutes an overarching threat that affects all others, and so the original assessment was accepted. The TLH of predators was changed to "known" for the St. Clair River because of the muskrat population in the area.

One participant noted that there was a high amount of boater traffic in the St. Clair River that impacted the sediment. Recreational activity for the river was assigned a TLH of "known", with a TI of "low" and a certainty of 3. Lake Erie was assigned a TLH of "unlikely", with a TI of "low" and a certainty of 3. For physical loss of habitat, the St. Clair River was assigned a TLH of "known", with a TI of "low" and a certainty of 3. Lake Erie was assigned the same.

The presentation continued with assessments of the Sydenham River. The TLH of altered flow regimes was changed to "known", while the TLH of predation was changed to "likely". One participant noted that there was a high level of ATV activity in the river, so the TLH was assigned "known" with a TI of "low". The physical loss of habitat was assigned the same.

The overall threat to Wavy-rayed Lampmussel was discussed briefly. The temporal extent of altered flow regimes was changed to "chronic".

ALLOWABLE HARM

Presenter: Jennifer Young

The presentation on allowable harm included the Wavy-rayed Lampmussel life cycle, parameter estimates of its life history, sensitivity and allowable harm, recovery times and strategies, and uncertainties of the current research.

One participant asked why the study had divided adult mussels into two groups. The presenter responded that the separation helps to tease apart the dynamics of the various stages; older mussels are larger and produce more glochidia. She added that the model could be structured in terms of age, rather than life stages.

The allowable harm calculated for the Grand and Thames rivers generated some discussion. A participant inquired as to the sources of the parameters for juvenile and adult Wavy-rayed Lampmussel; the presenter answered that the parameters were taken from existing literature. Another asked if the shorter generation time in the Grand River meant that there are fewer young individuals in the Thames. A participant responded yes, and that the study used the COSEWIC average ages of reproduction.

One participant asked why the elasticity of overwinter juveniles would be negative. It was explained as a product of how the researchers estimated overwintering survival; winter survival of bass was a factor, but the presenter hadn't found any hard data on the matter. There was no evidence to suggest that overwintering survival is higher than other survival rates.

There was some discussion surrounding glochidia drop-off rates. A participant suggested that glochidia drop off when water temperatures reach approximately 15°C. Another observed that bass fishing season coincides with the water reaching this temperature. Glochidia survival rate would be higher if they dropped off before fishing season began. The observation was made that older bass can be immune to glochidia, and also that glochidia take longer to drop off bigger fish.

RECOVERY PROJECTIONS

Presenter: Jennifer Young

The presentation on recovery projections covered recovery targets, strategies, and recovery times, as well as allowable harm and sources of uncertainty.

It was determined that the growth rate was most sensitive to changes in adult survival. However, sensitivity at various life stages depends on the nature of the threat. The presenter confirmed that an increase in adult survival (which would be difficult, because the rate is already high) would result in a shorter recovery time. Allowing harm, on the other hand, exponentially increases the time that it would take for the population to recover.

A participant then asked why harm would be allowed; it was explained that the point of the study was to demonstrate that allowing harm results in the population decreasing or becoming stagnant. A participant asked if the rates were comparable to those of fish; it was confirmed that they were. The presenter reminded the participants that the estimates given in the presentation were conservative.

A participant confirmed that the study assumed no additional harm on top of the survival estimates. The question was raised as to whether or not the Thames River population would recover in the projected 18 years if recovery teams allowed no additional harm from this point forward. The presenter responded in the affirmative, provided that all the assumptions that the model made were valid. Another participant added that it was encouraging to see that the recovery might not take as long as people had originally thought, depending on when the process began.

ALTERNATIVES TO ACTIVITIES/FEASIBILITY MITIGATION METHODS

Presenter: Lynn Bouvier

The presentation addressed the Pathways of Effect (PoE), additional mitigation and alternatives measures to activities which cause harm to Wavy-rayed Lampmussel.

The presenter noted that DFO Fish Habitat Management and DFO Science have created a document that lists all PoE, as well as potential mitigations and alternatives to break pathways (Coker et al. 2010). The document is to be used as a companion to RPAs and to provide alternatives and mitigations for habitat-related threats.

Regarding the mitigation measures for exotic species, a participant inquired into the place of ballast treatment for shipping in the Great Lakes. It was argued that this section of the report might not be the place for this topic. There was some resulting discussion surrounding national,

international, and local mitigation strategies. The presenter explained that the mitigations proposed were meant to offer broad strategies to consider implementing at a local level. The participants concurred that the restriction of recreational water use was a major vector for invasive species and was broad enough to be included under "Mitigations".

During the overview of the "Alternatives" section of the same category, there was some discussion about what constitutes an "authorized introduction". The presenter gave the example of Smallmouth Bass (*Micropterus salmoides*), which have been released for recreational purposes. The participants also agreed that exclusion zones could be added under the mitigation measures for fish hosts, and that harvesting could be included under the mitigation measures for predation. A participant noted that education is a key component of this strategy.

SOURCES OF UNCERTAINTY

Presenter: Lynn Bouvier

All sources of uncertainty were presented and there were no suggestions for revisions from the participants.

SUMMARY OF DISCUSSION

Presenter: Todd Morris

In summary, it was decided that:

- The current distribution of the Wavy-rayed Lampmussel includes the Ausable, Grand, Maitland and Thames rivers as well as the St. Clair River and delta.
- Wavy-rayed Lampmussel is thought to be extirpated from Lake Erie, Lake St. Clair proper (excluding St. Clair River delta) and the Detroit River, as well as the Sydenham River where it has not been recorded since 1971 despite substantial sampling.
- Habitat requirements for the Wavy-rayed Lampmussel are the following:
    - Gills of the appropriate host fish for the glochidial life stage;
    - Riverine systems: small- to medium-sized, clear rivers in shallow riffle and run areas on sand or gravel substrate for juvenile and adult life stages;
    - Lacustrine systems: shallow sand flats or wave-washed shoals for juvenile and adult life stages.
- For recovery targets in the Grand River, the number of adults required to achieve a 99% probability of persistence over 250 years depends on the assumed catastrophe scenario.
- To achieve a 99% probability of persistence over 250 years will require:
    - 1500 adult females per population, given a 15% chance of partial catastrophe per generation;
    - 83 000 adult females per population, given a 15% chance of full catastrophe per generation.
- For recovery targets in the Thames River, achieving a 99% probability of persistence over 250 years will require:
    - 31 adult females per population, given a 15% chance of partial catastrophe per generation.
    - 420 adult females per population, given a 15% chance of full catastrophe per generation

- Recovery times assume 15% probability of partial catastrophe and growth rates of 1.08 and 1.18 respectively.
- Population modeling indicates that in the absence of both recovery efforts and additional harm, populations between 2-20% of the recovery target have a 95% chance of reaching the target in 46-85 years (Grand River), or 18-30 years (Thames River).
- Population dynamics were most sensitive to changes in adult survival. Recovery time is reduced by approximately half with a 10% increase in adult survival.
- The greatest threats to the survival and persistence of extant Wavy-rayed Lampmussel populations are related to increased levels of contaminants and toxic substance, increases in nutrient loading, and the introduction of exotic species.
- Secondary threats included increases in turbidity and sediment loading, and those threats related to the fish hosts.
- Threats affecting Wavy-rayed Lampmussel to a lesser or unknown degree include altered flow regimes and predation.
- The growth rate of Wavy-rayed Lampmussel populations is most sensitive to the survival of adults.
    - Harm to vital rates of the Grand River population should be less than: 14% for glochidial survival or adult fecundity or 9% for juvenile survival or 6% for adult survival.
    - Harm to vital rates of the Thames River population should be less than: 33% for glochidial survival or adult fecundity or 22% for juvenile survival or 14% for adult survival.

All points were reviewed for readability. There was some discussion surrounding whether or not to distinguish between adult stages in the review of "allowable harm". The participants decided to refer to all adults as members of one life stage. It was also suggested that the summary include the point that any level of harm delays the time to recovery. The point was made in the "Science Advice on Allowable Harm" section of the report.

In the same section, a participant noted that researchers need to identify what harm to Wavy-rayed Lampmussel populations is acceptable (i.e., mussel relocation as a mitigation method to prevent greater harm). Another participant asked if there is evidence that relocation harms mussels; it was confirmed that for relocated specimens there is a 2% to 4% mortality rate. It was also noted that scientists do not allow any harm to a population if they do not have data on that population. Some discussion followed about whether a 2% to 4% mortality rate constitutes "harm"; it was decided that it does constitute "allowable harm".

The author stated that she would modify the documents from the meeting in accordance with the groups' comments. The participants would have two weeks to review the changes before the final draft was submitted.

REFERENCES

Bouvier, L.D. and T.J. Morris. 2010. Information in support of a Recovery Potential Assessment of Wavy-rayed Lampmussel (*Lampsilis fasciola*) in Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/074. v + 25 p.

Coker, G.A., D.L. Ming, and N.E. Mandrak. 2010. Mitigation guide for the protection of fishes and fish habitat to accompany the species at risk recovery potential assessments conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904. vi + 40 p.

DFO. 2007. Revised protocol for conducting recovery potential assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/39. 11 p.

Young, J.A.M. and M.A. Koops. 2010. Recovery potential modelling of Wavy-rayed Lampmussel (*Lampsilis fasciola*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/073. iv + 20 p.

Zanatta, D.T., S.J. Fraley and R.W. Murphy. 2007. Population structure and mantle display polymorphisms in the Wavy-rayed Lampmussel, *Lampsilis fasciola* (Bivalvia: Unionidae). Can. J. Zool. 85:1169-1181.

Appendix 1. Terms of Reference

Recovery Potential Assessment of Wavy-rayed Lampmussel

Regional Advisory Meeting – Central and Arctic Region

Burlington Art Centre
1333 Lakeshore Road
Burlington, ON

26 May 2010

Co-chairs: Todd Morris and Marten Koops

Background

In October 1999, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Wavy-rayed Lampmussel as Endangered. The reason for designation being that there were documented decreases in population sizes and in numbers of populations. In June 2003, Wavy-rayed Lampmussel was added to Schedule I of the *Species at Risk Act* (SARA).

Fisheries and Oceans Canada (DFO) Science has been asked to undertake a Recovery Potential Assessment (RPA) for the Wavy-rayed Lampmussel. DFO Science developed the RPA framework to provide the information and scientific advice required for the Department to meet various requirements of the SARA including listing decisions, authorizations to carry out activities that would otherwise violate the SARA and development of recovery strategies. The advice in the RPA may be used to inform both scientific and socio-economic elements of the listing decision, as well as development of a recovery strategy and action plan, and to support decision-making with regards to the issuance of permits, agreements and related conditions, as per section 73, 74, 75, 77 and 78 of SARA.

This advisory meeting is being held to assess the recovery potential of Wavy-rayed Lampmussel. The resulting RPA Science Advisory Report will summarize the current understanding of the distribution, abundance and trend of this species, along with recovery targets and times to recovery while considering various management scenarios. The current state of knowledge about habitat requirements, threats to both habitat and Wavy-rayed Lampmussel, and measures to mitigate these impacts, will also be included in the Science Advisory Report.

Objectives

The intent of this meeting is to assess the recovery potential of the Wavy-rayed Lampmussel using the 17 steps in the RPA framework outlined in the Summary section of the Revised Protocol for Conducting Recovery Potential Assessments (available at: http://www.dfo-mpo.gc.ca/csas/Csas/status/2007/SAR-AS2007_039_e.pdf). The advice will be provided to the DFO Minister for her consideration in meeting various requirements of SARA for this species.

Products

The meeting will generate a proceedings report summarizing the deliberations of the participants. This will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series. There will be CSAS Research Document(s) produced in relation to the

working paper(s) presented at the workshop. The advice from the meeting will be published in the form of a Science Advisory Report.

Participants

Experts from DFO, Environment Canada, Ontario Ministry of Natural Resources, Walpole Island First Nations, conservation authorities and academia have been invited to this meeting. Participants will not exceed a maximum of 15 people.

Appendix 2. Meeting Participants

Recovery Potential Assessment of Wavy-rayed Lampmussel

Regional Advisory Meeting – Central and Arctic Region

Burlington Art Centre
1333 Lakeshore Road
Burlington, ON

26 May 2010

LIST OF ATTENDANTS

Last Name	First Name	Affiliation
Andreae	Muriel	St. Clair Conservation Authority
Bouvier	Lynn	Fisheries and Oceans Canada
Boyko	Amy	Fisheries and Oceans Canada
Coppaway	Clayton	Note-taker
Doherty	Andrea	Fisheries and Oceans Canada
Jean	Kari	Ausable-Bayfield Conservation Authority
Koops	Marten	Fisheries and Oceans Canada
Mackie	Gerry	University of Guelph/Emeritus
McGoldrick	Daryl	Environment Canada
McNichols	Kelly	University of Guelph
Morris	Todd	Fisheries and Oceans Canada
Young	Jen	Fisheries and Oceans Canada
Wright	Jen	Grand River Conservation Authority

Appendix 3. Agenda

Recovery Potential Assessment of Wavy-rayed Lampmussel

Regional Advisory Meeting – Central and Arctic Region

Burlington Art Centre
1333 Lakeshore Road
Burlington, ON

26 May 2010

Co-chairs: Todd Morris and Marten Koops

26 May (Wednesday)

1. Welcome and Introductions	Todd Morris
2. Purpose of Meeting	Todd Morris
3. Species Status and Habitat Requirements	Lynn Bouvier
Break (refreshments provided)	
4. Recovery Targets	Marten Koops
5. Population Status	Lynn Bouvier
Lunch (provided)	
6. Threats	Todd Morris
7. Allowable Harm	Jennifer Young
Break (refreshments provided)	
8. Recovery Projections	Jennifer Young
9. Alternatives to Activities/Feasible Mitigation Methods	Lynn Bouvier
10. Summary and Wrap-up	Todd Morris